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13. ABSTRACT *(Maximum 200 words)*

STM studies are being carried out on Si(100)-(2x1) single crystal surfaces to understand the statistical site distribution of H atoms and Cl atoms. Procedures for producing the clean Si(100) surface with wide terraces have been devised, and preliminary studies have been carried out using three other measurement techniques.

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An Unexpected Adsorption Site Exclusion Process on Si(100)-(2x1)

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The objective of this research is to study the relative behavior of two halogen containing molecules, Cl_2 and HCl, as they interact with the Si(100) surface. Several measurement methods are employed.

It has been found that Cl_2 is favored over HCl for delivering high coverages of chlorine to the Si(100) surface. While one might expect that HCl would produce 1/2 the coverage of chlorine compared to Cl_2 as an adsorbate in dissociative adsorption, in fact the ratio is more like 1/4.

The measurements have been done using three independent methods. These are:

1. The Auger spectroscopic signal from chlorine at saturation for Cl_2 and HCl (Figure 1).

2. The yield of the etching product, $SiCl_2$, from Cl_2 and HCl (Figure 2).

3. The coverage of H from HCl (Figure not shown).

A fourth measurement, designed to statistically study this phenomenon at the atomic level of resolution is being developed, using the scanning tunneling microscope(STM). Here the Si(100) surface will be probed during adsorption to count the sites covered with the adsorbate atoms from Cl_2 and HCl. We have learned how to make Si(100) surfaces having large terraces and less that 10% surface defects. An STM picture of the clean surface is shown in Figure 3.

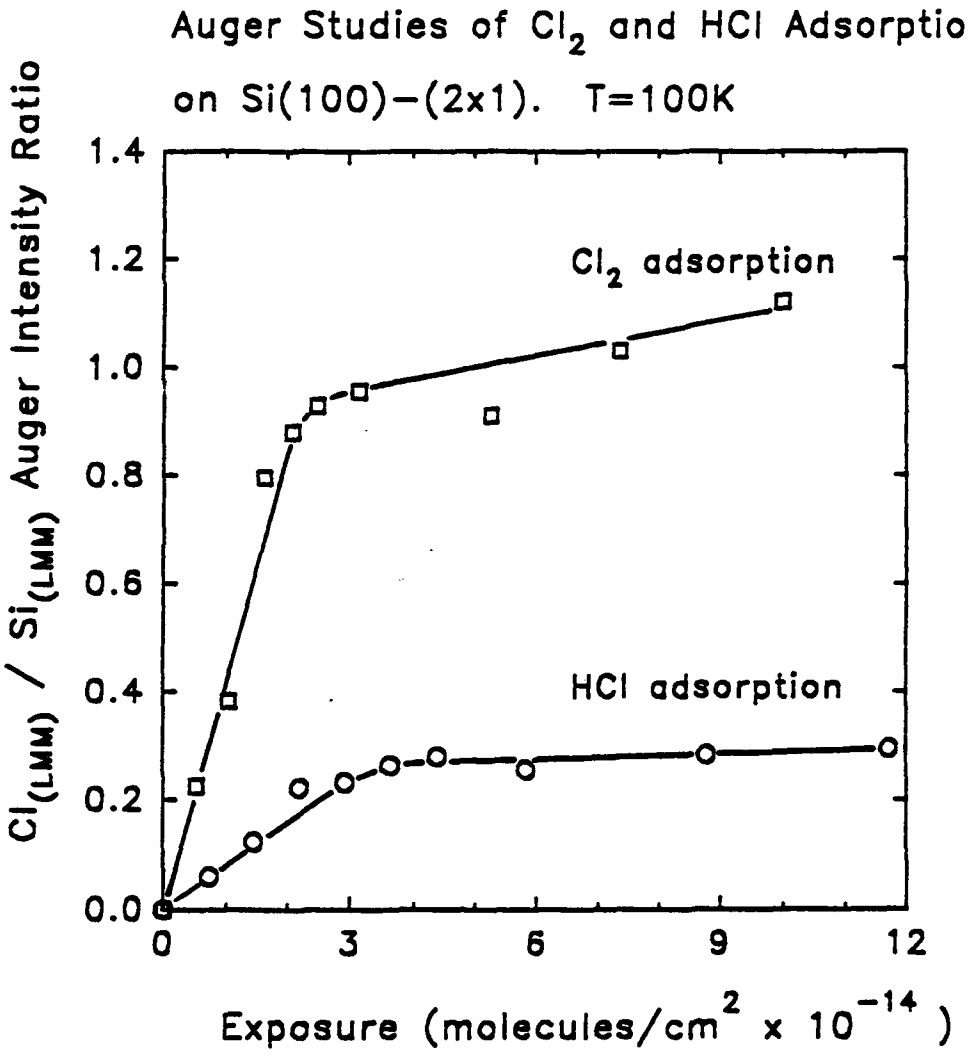

Figure 1. Development of Cl Auger signal from Cl_2 and HCl.

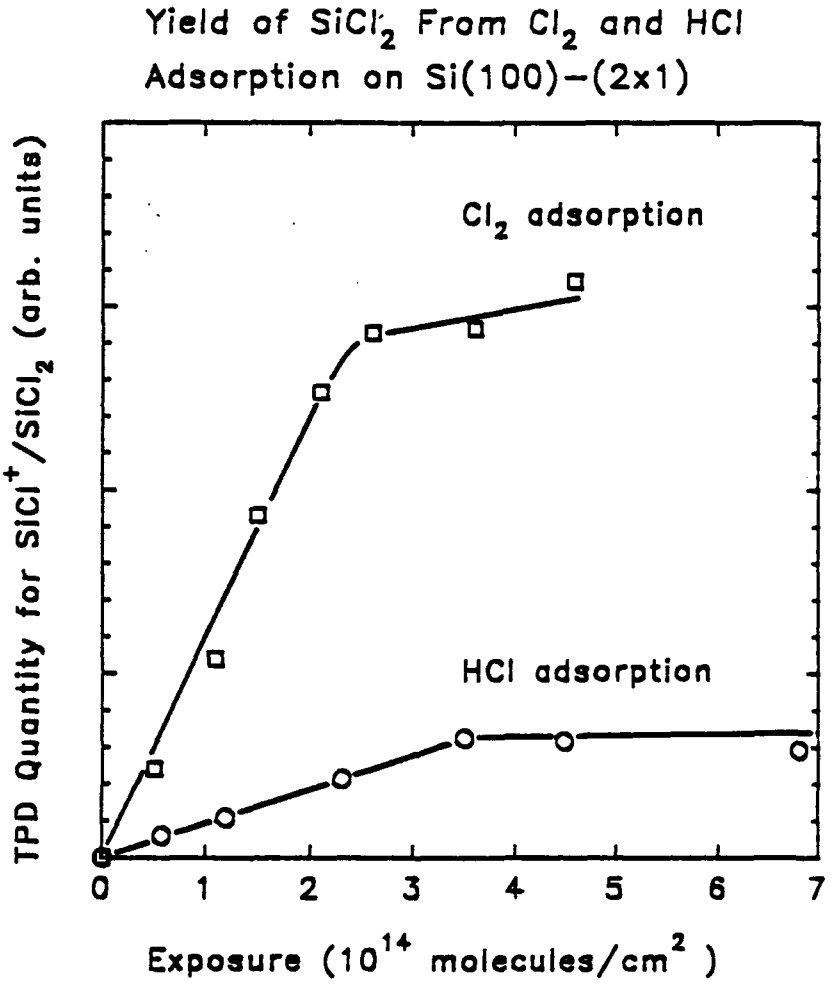

Figure 2. Development of $SiCl_2$ etching product from Cl_2 and HCl.

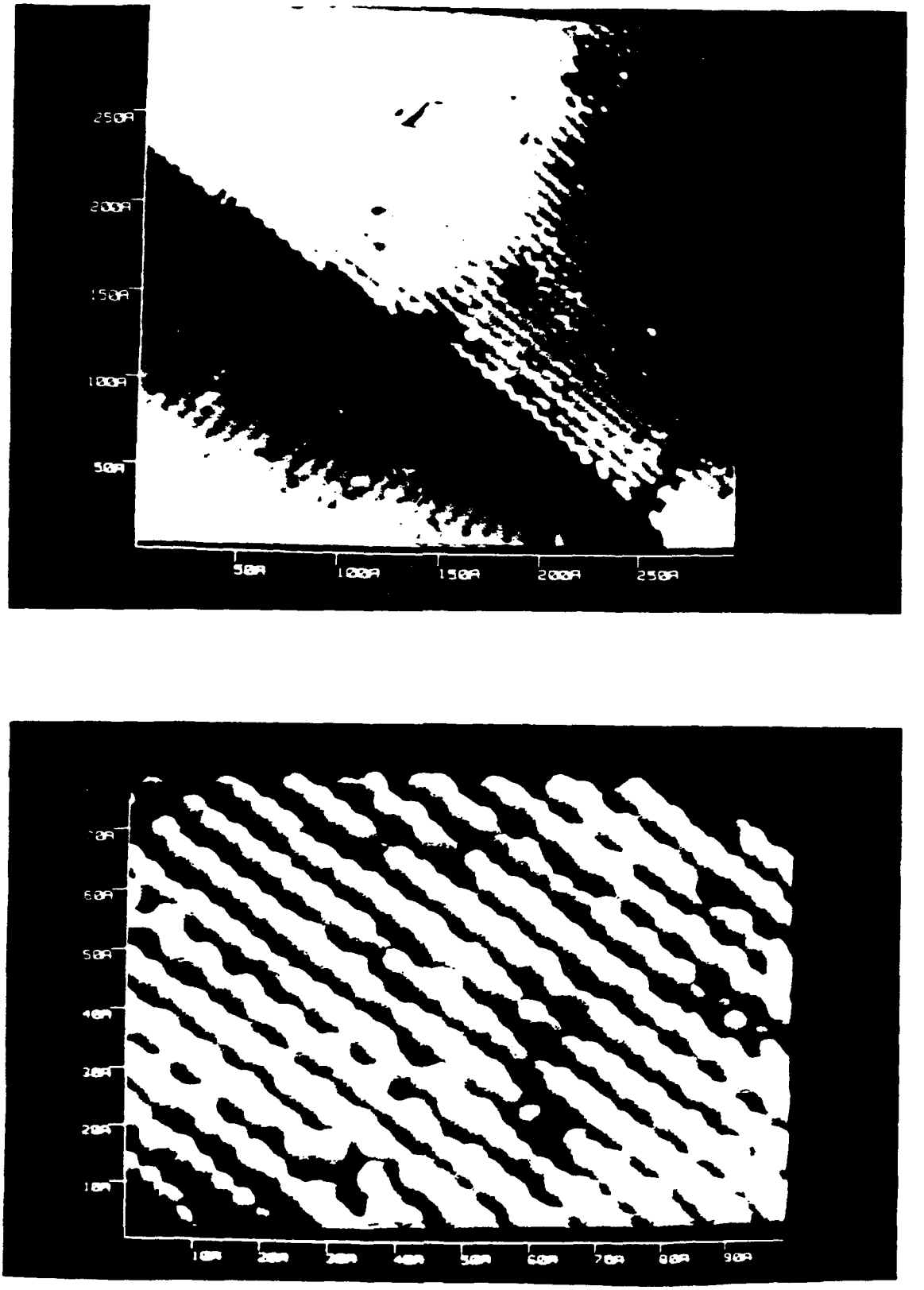

Figure 3. STM micrograph of Si(100) surface with wide terraces, at two magnifications.

A computer-controlled annealing procedure for producing wide-terrace Si(100) has been devised. The temperature program involves a ramped heating, stable temperature, and ramped cooling cycle as shown in Figure 4.

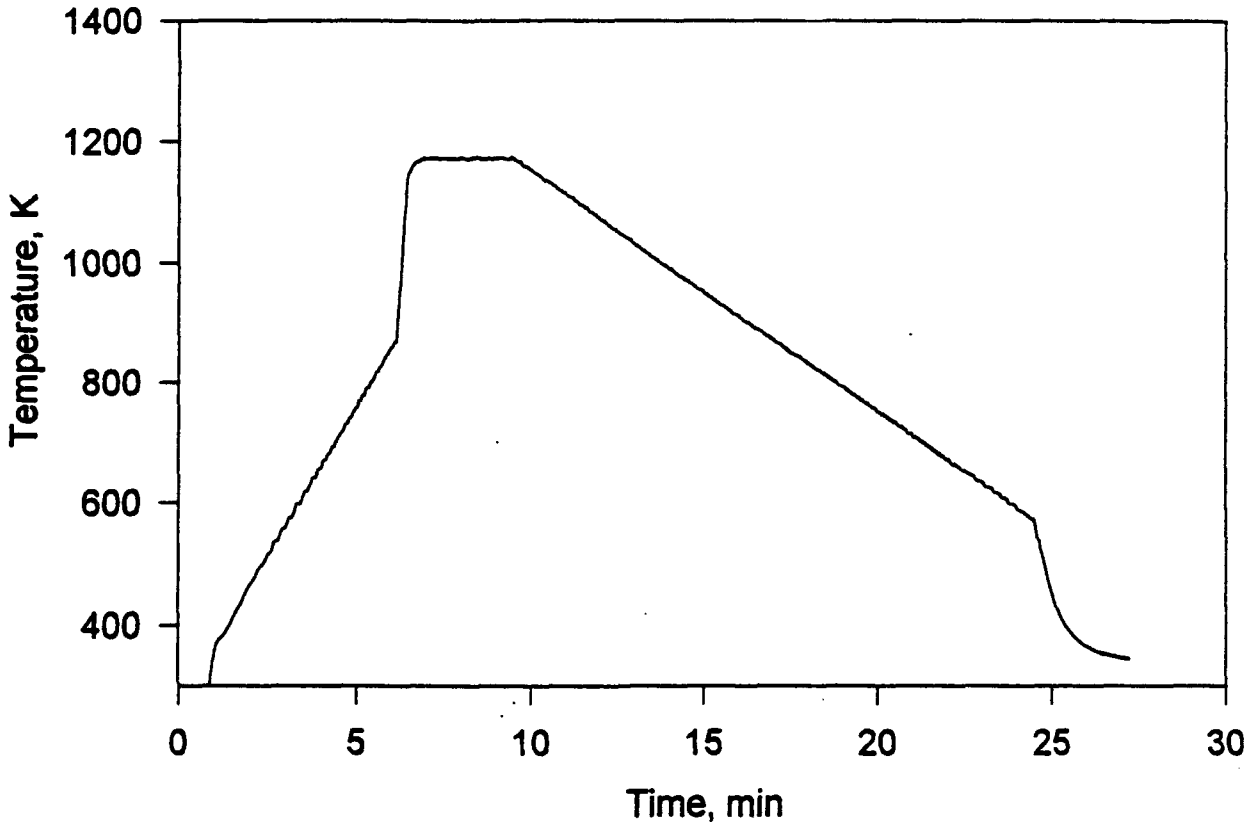

Figure 4. Computer Controlled Annealing of Si(001).

During the next year, the statistical study of the adsorption of Cl_2 and HCl on the Si(100) surface will be performed, using the STM.